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Title
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Permalink
https://escholarship.org/uc/item/9t35s4kt

Journal
i-Perception, 5(1)

ISSN
2041-6695

Author
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Publication Date
2014-02-01

DOI
10.1068/i0643sas

Peer reviewed

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i-PERCEPTION
a Pion publication
i-Perception (2014) volume 5, pages 73 –74
dx.doi.org/10.1068/i0643sas ISSN 2041-6695 perceptionweb.com/i-perception

SHORT AND SWEET

Pattern specificity of contrast adaptation

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Received 19 January 2014, in revised form 31 January 2014; published 4 February 2014

Abstract. Contrast adaptation is specific to precisely localised edges, so that adapting to a flickering photograph makes one less sensitive to that same photograph, but not to similar photographs. When two low-contrast photos, A and B, are transparently superimposed, then adapting to a flickering high-contrast B leaves no net afterimage, but it makes B disappear from the A+B picture, which now simply looks like A.

Keywords: adaptation, flicker, contrast, contour.

Adapting to flicker can reduce sensitivity to subsequently viewed low-contrast test flicker (Pantle, 1971). Krauskopf, Williams, and Heeley (1982) reported visual adaptation to sinusoidal flicker. They found that thresholds for changes in luminance were raised following viewing a field varying in luminance (but were not altered by exposure to purely chromatic variation). Webster and Mollon (1994) extended these studies on 'contrast adaptation' from threshold elevation to suprathreshold perception. They concluded that light adaptation adjusts sensitivity to mean luminance, while adaptation to contrast (that is, to flicker) adjusts sensitivity to variations in luminance.

Like all the above authors, we adapted our observers to flicker. But whereas their test stimuli were unpatterned and flickering, ours are patterned and static. Where they studied time, we study space. We have found (for example, Anstis, 2013; Anstis and Greenlee, in press) that adaptation to a thin outline circle that flickered between black and white on a grey surround could reduce the perceived contrast of a whole low-contrast, congruent test disk. This phenomenon of 'contour adaptation' suggests that the brightness of an area is coded by signals along its borders.

Falconbridge, Ware, and Macleod (2010) adapted their observers to a vertical grating that flickered in counterphase. This reduced subsequent sensitivity to a test grating of the same orientation and spatial frequency—remarkably, even if the adapting grating flickered at such high rates, up to 80 Hz, the grating became invisible.

We now report that contrast adaptation is specific to precisely localised edges, so that adapting to a flickering photograph makes one less sensitive to that same photograph, but not to similar photographs. In all our movies the test stimulus was a low-contrast static photo portrait. Observers adapted first for 7 s to a high-contrast flickering version of the same photo, which alternated with its own photographic negative at a rate of 5.5 Hz. Result: In every case, the flickering adaptation made the static test photo subjectively fade out and disappear from view.

In Movie 1 (see supplementary online material at http://i-perception.perceptionweb.com/journal/I/volume/5/article/i0643sas) the test stimuli were two identical, low-contrast coloured portraits of 'Lena', side by side. Both adapting stimuli were congruent flickering Lenas, achromatic (greyscale) on the left and coloured on the right. Result: Both test Lenas disappeared from view, leaving only spatially uniform fields, which were coloured (pinkish) on the left but grey on the right. This suggests that colour and luminance could adapt independently.

In Movie 2 (see supplementary online material) the test stimuli were two transparently superimposed, low-contrast greyscale photos. We used one photo of Albert Einstein and one of Marilyn Monroe

(Schyns & Oliva, 1997). Two identical Einstein+Marilyn photos were set up side by side with a fixation point between them; each looked like a confused jumble, and neither face could be seen clearly. The adapting stimuli were high-contrast flickering versions of the two single components: Einstein on the left and Marilyn on the right. Result: Adaptation made Einstein fade out subjectively from the left-hand Einstein+Marilyn, which now looked like Marilyn. Conversely, Marilyn subjectively faded out from the Einstein+Marilyn on the right, which now looked like Einstein. This adaptation selectively picked out (and degraded) the test photo with which it was congruent, and had little effect on the other, superimposed but noncongruent test photo.

Movie 3 (see supplementary online material) shows how adapting to achromatic flicker can alter perceived test colours. We used the same two paintings as we have used before (Anstis Vergeer & Van Lier, 2012a, 2012b). These are *The Blue Boy* (1770) by Thomas Gainsborough, and *La Source* (1856) by Jean-Auguste-Dominique Ingres. These two full-length portraits have roughly the same size and shape but very different colouring. *The Blue Boy* is in cool bluish hues while *La Source* is infused with warm flesh tones.

We transparently superimposed low-contrast copies of these two paintings, which contained both luminance and colour. The result was a jumble of colour and luminance information in which neither painting could be seen clearly. Two of these BlueBoy+Source pictures were exposed side by side as test stimuli. We adapted to high-contrast flickering greyscale pictures, *The Blue Boy* on the left and *La Source* on the right. When we then viewed the jumbled coloured double pictures, the left-hand BlueBoy+Source looked like *La Source*, tinged with pink, while the right-hand BlueBoy+Source looked like *The Blue Boy*, tinged with blue. So adaptation to achromatic flickering luminance contours made these two identical test pictures looked different, not only in shapes but also in colours.

Acknowledgments. This work was supported by a grant from the UCSD Department of Psychology. Thanks to Sae Kaneko for assistance in making the movies, and to Don Macleod for helpful advice.

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